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# METHOD FOR MANUFACTURING COLOR FILTER SUBSTRATE

## [Abstract]

15 PROBLEM TO BE SOLVED: To provide a method for manufacturing a color filter  
substrate preventing residual air bubbles from being generated in a liquid crystal  
cell after sealing a liquid crystal therein without canceling an advantage of a method  
for manufacturing a liquid crystal display device using a dripping method, i.e.,  
without extending evacuation time for sticking the color filter substrate to a counter  
20 substrate.

SOLUTION: Prior to formation of the liquid crystal cell, the color filter substrate is  
set up in a thermostat under atmospheric pressure, is heated to a specified  
temperature, furthermore, is kept at the specified temperature for a specified time,  
subsequently is returned to normal temperature and is subjected to degassing  
25 treatment.

[Claim(s)]

[Claim 1] A manufacturing method of a color filter substrate comprising,  
a step for arranging the color filter substrate in a thermostat under atmospheric pressure,

- 5 a step for heating the substrate to a predetermined temperature and for maintaining for a predetermined time period, and  
a step for exposing the substrate to normal temperature and for degasifying the substrate.

- [Claim 2] The manufacturing method of the color filter substrate set forth in  
10 the claim 1, in a degasification process, a heating temperature is set to a temperature ranging from 150° to below 180°, and a maintaining period of the heating temperature is set to the time ranging from 6 hours to below 12 hours.

[Title of the Invention]

## MANUFACTURING METHOD OF A COLOR FILTER SUBSTRATE

[Detailed Description of the Invention]

[Field of the Invention]

5 The present invention is related to a manufacturing method of a color filter substrate used in a LCD(liquid crystal display) apparatus.

[Description of the Prior Art]

Recently, as the functions of a personal computer or a word processor equipped with LCD are getting diversified more and more, an apparatus having a color filter  
10 which can perform color display becomes a main stream. FIG. 3 shows a substrate of a general color filter. Further, FIG. 4 shows a general liquid crystal display apparatus. First of all, FIG. 3 will be explained. A color filter 6 is formed on a substrate 5, and thus a protection layer 7 is formed to cover a front side of the color filter 6. A transparent electrode 8 is formed with the protection layer 7 sandwiched  
15 therebetween and a insulating layer 9 is formed to cover a front side of the transparent electrode 8 and the protection layer 7, thereby forming a color filter substrate 4.

As shown in FIG. 4, a LCD apparatus using this color filter substrate 4 has a structure as follows. An opposing substrate 15 is formed by forming the transparent  
20 layer 8 and the insulating layer 9 on a substrate 14 sequentially.

An orientation control layer 10 is formed on the opposing substrate 15 and the color filter substrate 4 formed as above, respectively. After arranging a spacer 11 between the opposing substrate 15 and the color filter substrate 4, a liquid crystal cell is formed by bonding the orientation control layer 10 with a seal member  
25 12.

Further, a LCD apparatus 16 is formed by injecting liquid crystal 13 into the inside of a liquid crystal cell.

[Means for Solving the Problem]

In a LCD apparatus 16 having such color filter substrate 4, a gas can be generated  
5 easily from the color filter 6 and the protection layer 7, due to a heating process when stabilizing the orientation of the orientation control layer 10, or the pressure reduction state when sealing the liquid crystal 13. If a gas is generated from the color filter 6 and the protection layer 7, since remaining foams are generated in the liquid crystal cell after sealing the liquid crystal 13, there is a problem that the LCD  
10 apparatus 16 has a serious defects.

Therefore, Japanese Laid-Open Patent Publication 1992-42129 describes a method by which it is possible to perform degasification process of a color filter by maintaining the liquid crystal cell under pressure reduction and heating state for a long time, before injecting the liquid crystal into the liquid crystal cell and it is  
15 possible to prevent the remaining foams from being generated after injecting the liquid crystal.

But this method is not suitable for a dropping method described in Japanese Laid-Open Patent Publication 1987-89025 or Japanese Laid-Open Patent Publication 1988-179323. That is, the dropping method includes a step for dropping a  
20 predetermined amount of the liquid crystal on at least one side of the color filter substrate and the opposing substrate, and a step for sealing the liquid crystal, and making a cell by bonding both substrates under pressure reduction state simultaneously.

Thus, as described above, if the method for maintaining the liquid crystal cell under  
25 pressure reduction and heating state for a long time, before injecting the liquid

crystal 13 into the liquid crystal cell is used as a dropping method, there was a problem that the advantage of making both substrates be a cell within a very short time can not be realized.

The object of the present invention is to provide a manufacturing method of a color  
5 filter substrate which can prevent remaining foams from being generated within the liquid crystal cell after sealing the liquid crystal without damaging the advantages of manufacturing method of LCD apparatus according to a dropping method, that is, without extending vacuum maintenance time when bonding the color filter substrate and the opposing substrate.

10 The manufacturing method of a color filter substrate of the present invention is characterized in that it can apply a degasification process after heating the color filter substrate in a thermostat under the atmospheric pressure before forming the liquid crystal cell.

According to the manufacturing method of a color filter substrate of the present  
15 invention, since the degasification process is performed before the liquid crystal cell is formed, it is possible to prevent remaining foams from being generated within the liquid crystal cell after sealing the liquid crystal, under the same conditions like the prior art without extending vacuum maintenance time when bonding the color filter substrate and the opposing substrate. In addition, it is possible to shorten the  
20 process time for degasifying the color filter substrate.

#### [Embodiment of the Invention]

A manufacturing method of a color filter substrate set forth in the claim 1 is characterized in that it comprises a step for arranging the color filter substrate in the thermostat, under the atmospheric pressure, a step for heating to a predetermined  
25 temperature, and for maintaining for a predetermined time period, a step for

exposing it to the normal temperature, and for degasifying.

- According to this structure, it is possible to degasify within a short time since the upper limit of heating temperature can set to the heat-proof temperature of a color filter substrate by arranging the color filter substrate in the thermostat, under the
- 5 atmospheric pressure, heating to a predetermined temperature, maintaining for a predetermined time period, exposing it to the normal temperature, and degasifying. Accordingly, in case of sealing based upon a dropping method using the color filter substrate processed according to the above method, it is possible to prevent the remaining foams from being generated within the liquid crystal cell after
- 10 sealing the liquid crystal without extending vacuum maintenance time at sealing time, that is, without damaging the advantages of the dropping method. it is possible to degasify under the atmospheric pressure, and it is possible to degasify within a shorter time with no time being required in making a vacuum when compared with the degasification under the pressure reduction. Further a large
- 15 scale of pressure reduction devices are unnecessary. In case of producing a color filter substrate using a large substrate, since the thermostat becomes large and thus it takes much time in making a vacuum, the production tact is shortened remarkably with respect to degasification process under the atmospheric pressure.
- 20 A manufacturing method of a color filter substrate set forth in the claim 2 is characterized in that in a degasification process, a heating temperature is set to the temperature ranging from 150° to below 180°, and a maintaining period of the heating temperature is set to the time ranging from 6 hours to below 12 hours.
- According to this configuration, excellent degasification process can be performed
- 25 for the color filter substrate.

Below, the embodiment according to the present invention will be explained with referring to FIG. 1R>1, and FIG. 2. Further, the conventional examples are explained by giving same reference numbers to same parts of FIG. 3R>3, and FIG 4.

5 FIG. 1 is a flowchart showing a manufacturing method of LCD apparatus using the manufacturing method of a color filter substrate of the present invention. A color filter substrate 4 described in FIG. 3 is formed by the first process A1.

In the second process A2, the color filter substrate 4 is arranged collectively in the thermostat such as a clean oven and so on, under the atmospheric pressure, and  
10 then the steps for heating the color filter substrate 4 to a predetermined temperature, maintaining for a predetermined time period, and degasifying it are performed.

FIG. 2 shows a device for performing degasification of the color filter substrate 4. A step for arranging the color filter substrate 4 a substrate holder 3 mounted in the  
15 thermostat, under the atmospheric pressure is performed. Then, after heating to a predetermined temperature, maintaining for a predetermined time period, and exposing it to the normal temperature, a step for degasifying a color filter 6 is performed.

In this degasification process, in case of the color filter substrate 4 having the  
20 protection layer 7 made of acrylate resin and the color filter 6 made of a polyester resin, it is possible to degasify the protection layer 7 and the color filter 6 by setting a maintaining period to the time ranging from 6 hours to below 12 hours and setting a heating temperature to the temperature ranging from 150° to below 180°. A sufficient degasification process can not be performed under other conditions  
25 except such temperature range and the process time.

In the third process A3, the steps for forming an orientation control layer 10 on the color filter substrate 4 to which a degasification process was applied, coating with a seal member 12, and dropping liquid crystal 13 on the cell region surrounded with the seal member 12.

- 5 On the other hand, like FIG. 3 representing a conventional example, in the fourth process A4, an opposing substrate 15 is formed by forming an insulating layer 9 and a transparent layer 8 on a surface of substrate 14.

And in the fifth process A5, the orientation control layer 10 is formed on the opposing substrate 15. In the sixth process A6, a spacer 11 is dispersed on the  
10 opposing substrate 15 by using the opposing substrate 15 formed as described above, and the color filter substrate 4, and the color filter substrate 4 having dropped liquid crystal 13 is stacked on it. Then, a LCD apparatus 16 is formed by hardening the seal member 12.

According to the manufacturing method of LCD apparatus, since the color filter  
15 substrate 4 is heated collectively in advance in the second process A2, it becomes unnecessary to degasify the color filter after the second process A2. Therefore, in the liquid crystal sealing process of the sixth process A6, it is possible to prevent remaining foams from being generated within the liquid crystal cell without extending vacuum maintenance, that is, without damaging the advantages of  
20 making both substrates be a cell within a very sort time.

Further, in this embodiment, the heating process of the color filter substrate 4 is performed after forming the insulating layer 9, but the heating process can be performed prior to forming the insulating layer 9, or after forming the orientation control layer 10.

- 25 Further, in this embodiment, coating of the sealing member 12 and dropping of the



liquid crystal 13 are performed on the color filter substrate 4, but same effects can be obtained in case of the opposing substrate 15.

[Effect of the Invention]

As is apparent from the above description, according to the manufacturing method  
5 of a color filter substrate of the present invention, it is possible to degasify within a short time since the upper limit of heating temperature can set to the heat-proof temperature of a color filter substrate. Accordingly, it is possible to prevent the remaining foams from being generated within the liquid crystal cell after sealing the liquid crystal without extending vacuum maintenance time when bonding the color  
10 filter substrate and the opposing substrate. Further, it is possible to degasify under the atmospheric pressure, and it is possible to degasify within a shorter time with no time being required in making a vacuum.

[Description of Drawings]

FIG. 1 is a flowchart showing a manufacturing process of a LCD apparatus according to the embodiment.

FIG. 2 is a drawing of degasification process of a color filter substrate according to  
5 the embodiment.

FIG. 3 is a drawing of a general color filter substrate

FIG. 4 is a drawing of a general LCD apparatus.